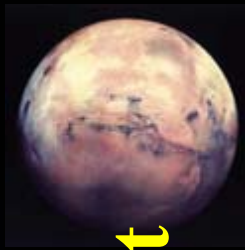




2nd ISS Treadmill Development “T2 Project”



3rd Annual Countermeasures Summit

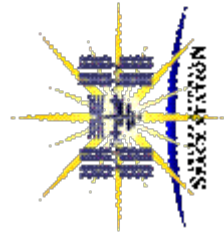
March 7, 2007



Kevin MacNeill, NASA Deputy Project Manager

Curt Wiederhoeft, Bioastronautics Contract, Project Manager

NASA Johnson Space Center

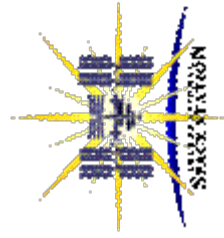


AGENDA



- **Second Treadmill, T2 Development**
 - Project Overview
 - Development Plan and Schedule
 - Project Challenges
 - Alignment of approach to “unconstrained” MMOP Requirements

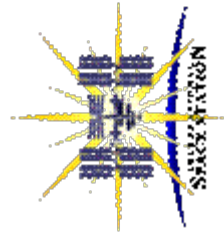




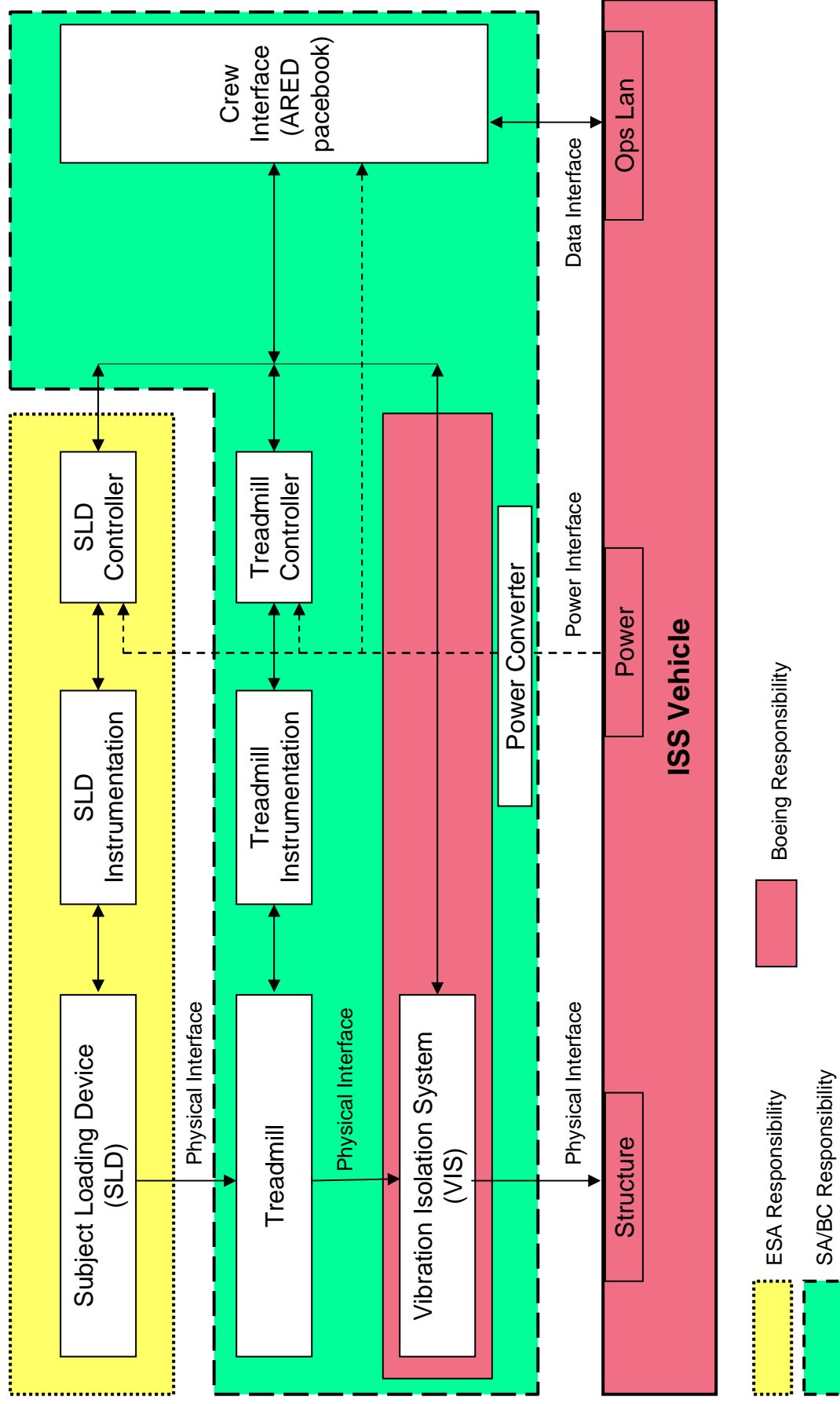
Project Overview

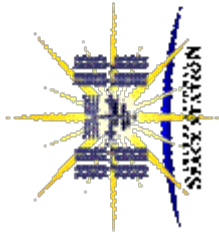


- **The Space Station Program Control Board (SSPCB) approved Change Request 010318A on February 16 2007, authorizing the development of a second treadmill for the ISS.**
 - The second ISS treadmill is required to meet the operational needs of a 6 man crew.
 - Delivery of the certified system is required by 9/30/08.
- **The SSPCB CR was very specific with respect to design approach and T2 location.**
- **Directive Summary:**
 - The T2 shall be located in the JEM, JPM1A5
 - SA/ Space Life Sciences Directorate through the Bioastronautics Contract (BC) shall:
 - Perform flight certification of a Commercial Off the Shelf (COTS) Woodway Path treadmill.
 - Develop and certify a crew data interface. The crew interface should optimize use of the COTS design and/or existing NASA design (such as the ARED Pacebook) when reasonable to do so.
 - Identify, develop (only as required) and certify a power supply to provide power from the ISS Vehicle to the treadmill system (crew interfaces, motor, controller and subject loading devices).
 - Identify, develop (as required) a contingency use passive subject loading device.
 - Integrate all elements of the COTS based treadmill
 - ESA provided Subject Loading Device (SLD)
 - Boeing provided Vibration Isolation System based upon PaRIS design and hardware
 - COTS or Government Furnished Equipment (GFE) Avionics



Treadmill Bilateral Development Concept





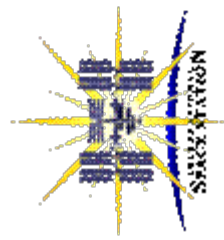
Overall concept



- The treadmill can fit within the interior envelope of an International Standard Payload Rack with sufficient space and volumetric margins to make the integration of hardware for mounting of the treadmill, VIS/Rack interface, subject Loading System and rack structural reinforcement components feasible.



ISOMETRIC VIEW



Hardware Elements

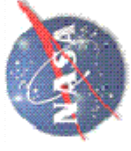


- COTS Woodway treadmill as the exercise machine (handrail will be removed)

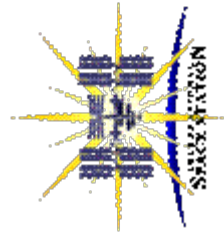




Hardware Elements



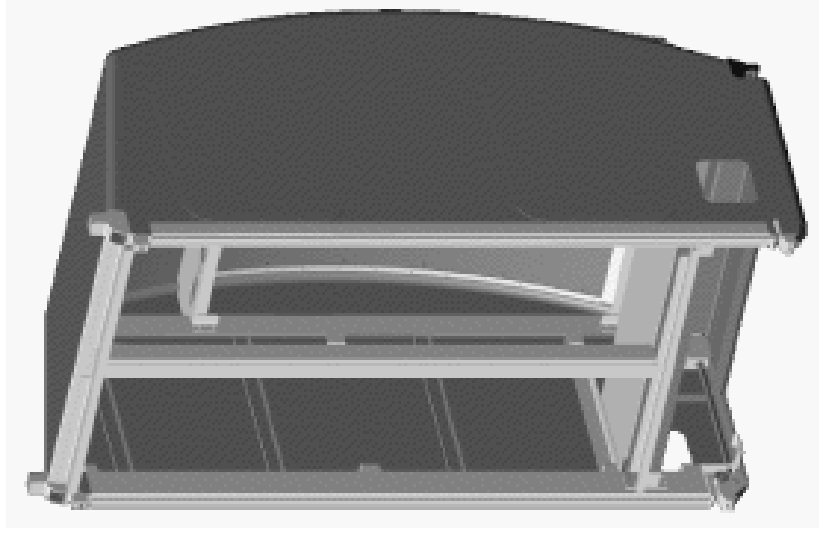
- Rationale to use COTS hardware was captured in the Bioastronautics Contract's *Final Report on the Findings of the COTS Treadmill*, November, 2006
 - Assessment was performed per NASA Engineering standards (EA-WI-016, *Hardware Utilization in Flight Hardware Development*)
 - Assessment established that the woodway treadmill met criteria for use of COTs hardware in a flight development
- Robust mechanical and electrical design coupled with high terrestrial reliability of system were key factors in the Woodway Treadmill passing the COTS assessment for flight hardware
 - Thousands of units being used in the field under “heavy” work conditions (Professional sports training, etc.)
- Minimal modifications required to meet majority of MMOP requirements and allow for integration into PaRIS rack

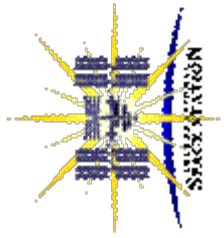


Hardware Elements



- International Standard Payload Rack (ISPR) will be the T2 “container”

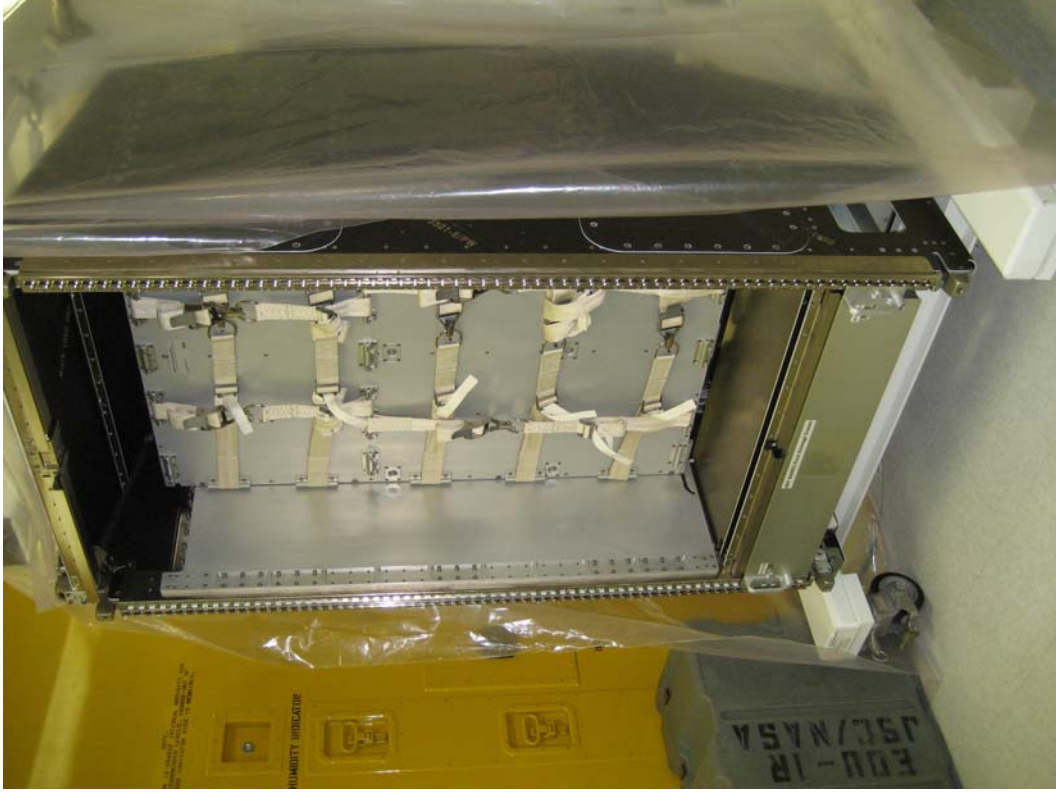


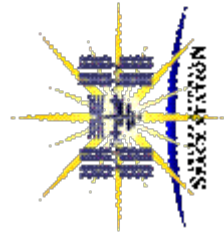


Hardware Elements, continued



- ISPR will require structural modifications to support T2 integration and operations
 - Same modification made to the MARES (Muscular Atrophy Resistive Exercise System)
 - Mods will provide additional strength, stiffness and provisions to hard mount the T2 in the rack
 - To meet vibration requirements, T2 will require ballast to increase inertia

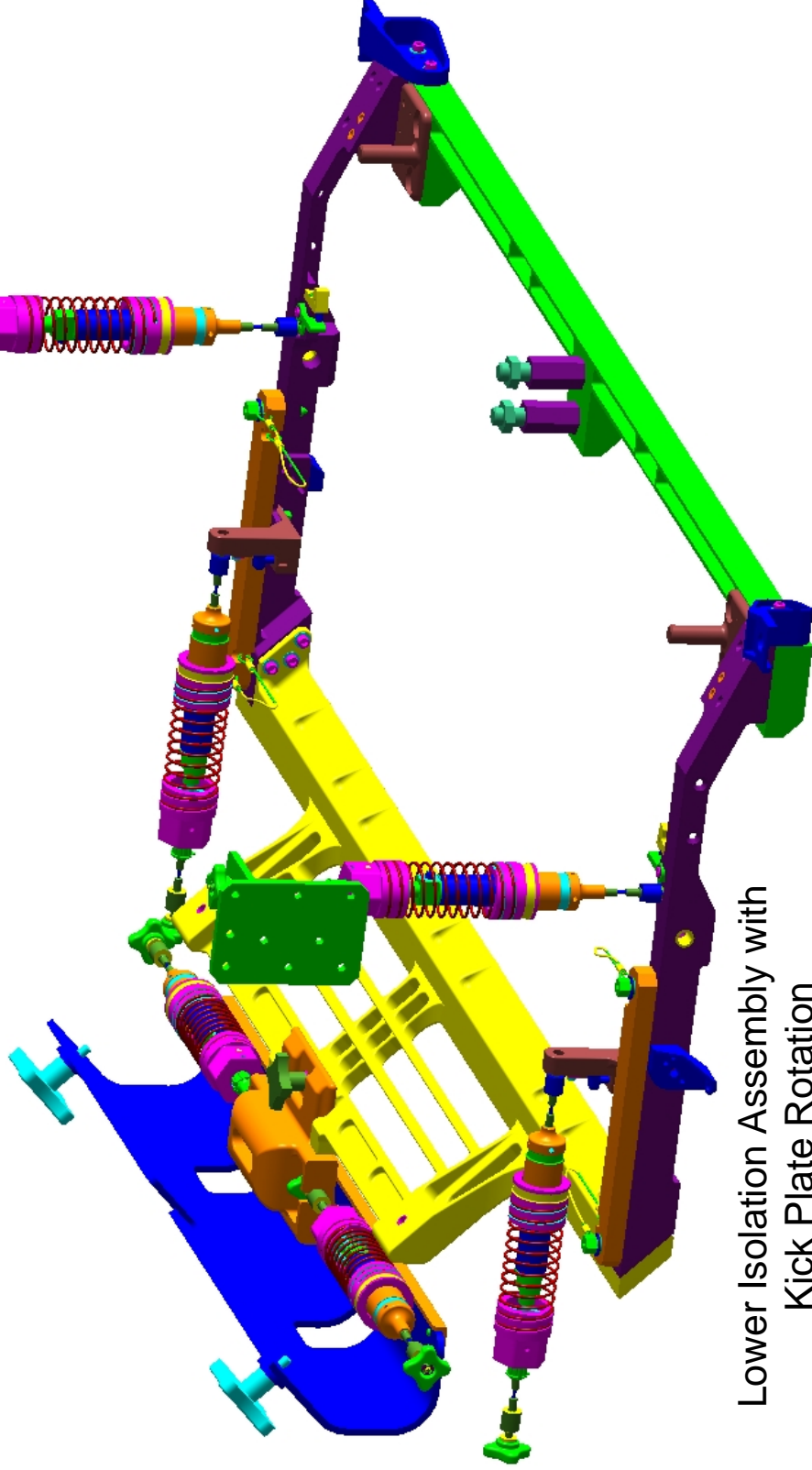




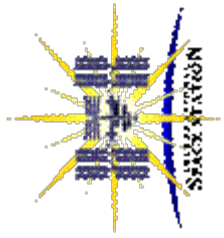
Hardware Elements/ PaRIS



- Passive Rack Isolation System (PaRIS), originally designed to protect sensitive Rack-installed payloads from vehicle vibrations, used “in reverse” to attenuate Rack vibrations back to the vehicle—Boeing Design



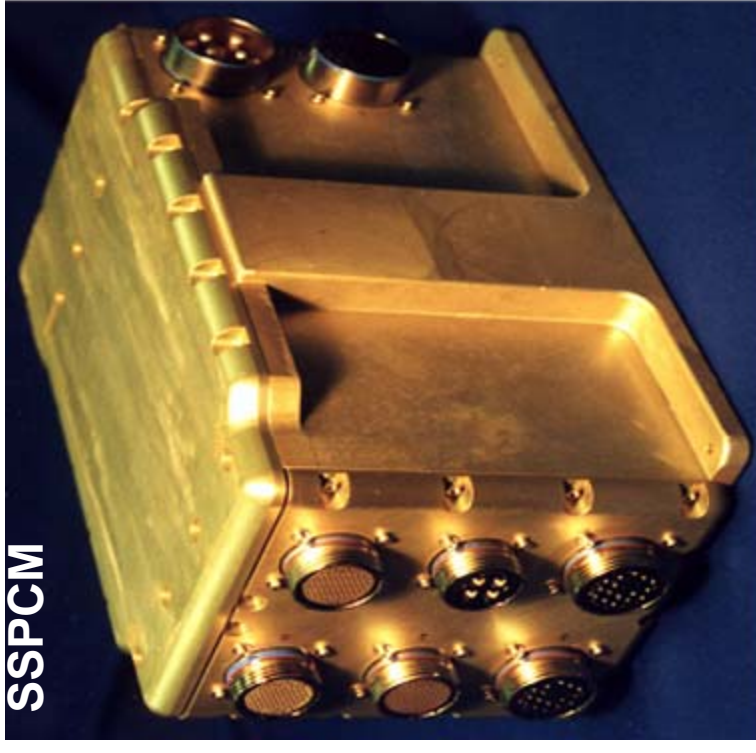
Lower Isolation Assembly with
Kick Plate Rotation

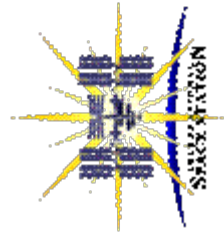


Hardware Elements, continued



- Power to the Treadmill
subsystems will be provided using the Space Station Power Control Module (SSPCM)
 - Capable of power up to 10 payloads w/in a rack
 - Hardware currently in ISS inventory (HHR Rack), therefore maximizes use of existing inventory to reduce T2 system cost
 - Can be used as-is or “cannibalized” for vehicle power distribution



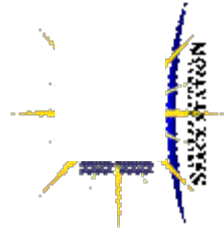


Hardware Elements, continued



- T2 system will generate significant amounts of heat during operation
 - Avionics Air Assembly (AAA) is designed to cool up to 10 payloads within a rack
 - Can be adapted for treadmill cooling
 - “AAA” also currently in ISS inventory, maximizing use of existing inventory to reduce T2 system cost



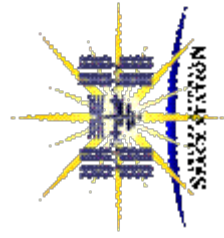


Hardware Elements



- Touchscreen Tablet PC, certified as the user interface for the Advanced Resistive Exercise Device (ARED), used as a control panel
 - Also currently in ISS inventory—reducing T2 System Cost



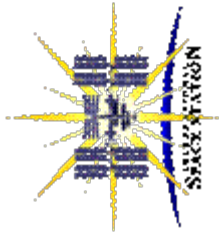


Hardware Elements, continued

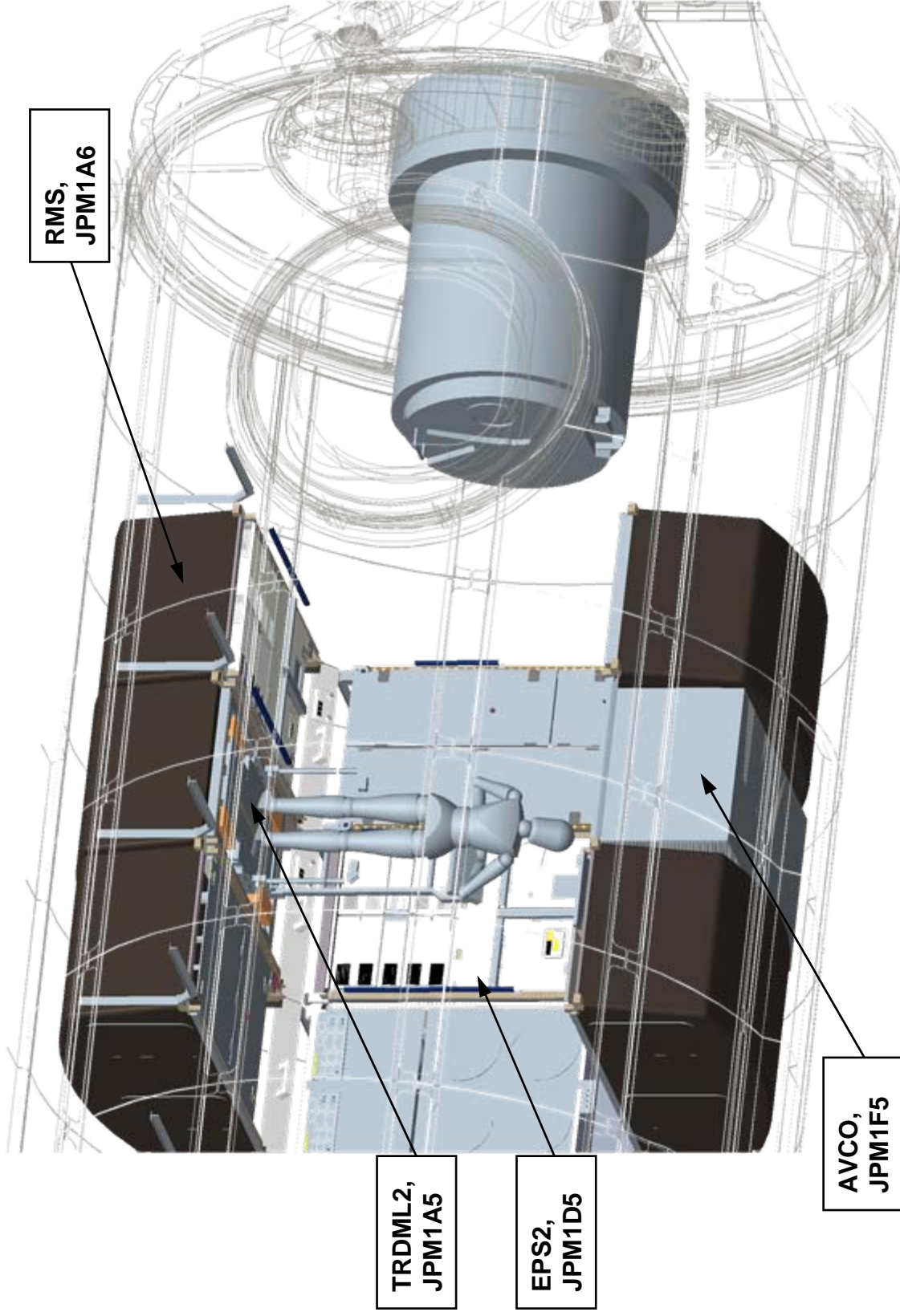


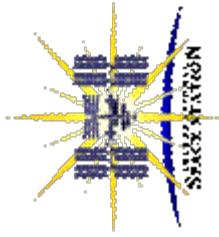
- Passive, contingency SLDs will make use of existing designs. Considerations include: TVIS bungees, or TVIS style with incremental improvements, Russian Subject Loading Device (BD1) or modified RED canisters.





TRDML2, JPM1A5





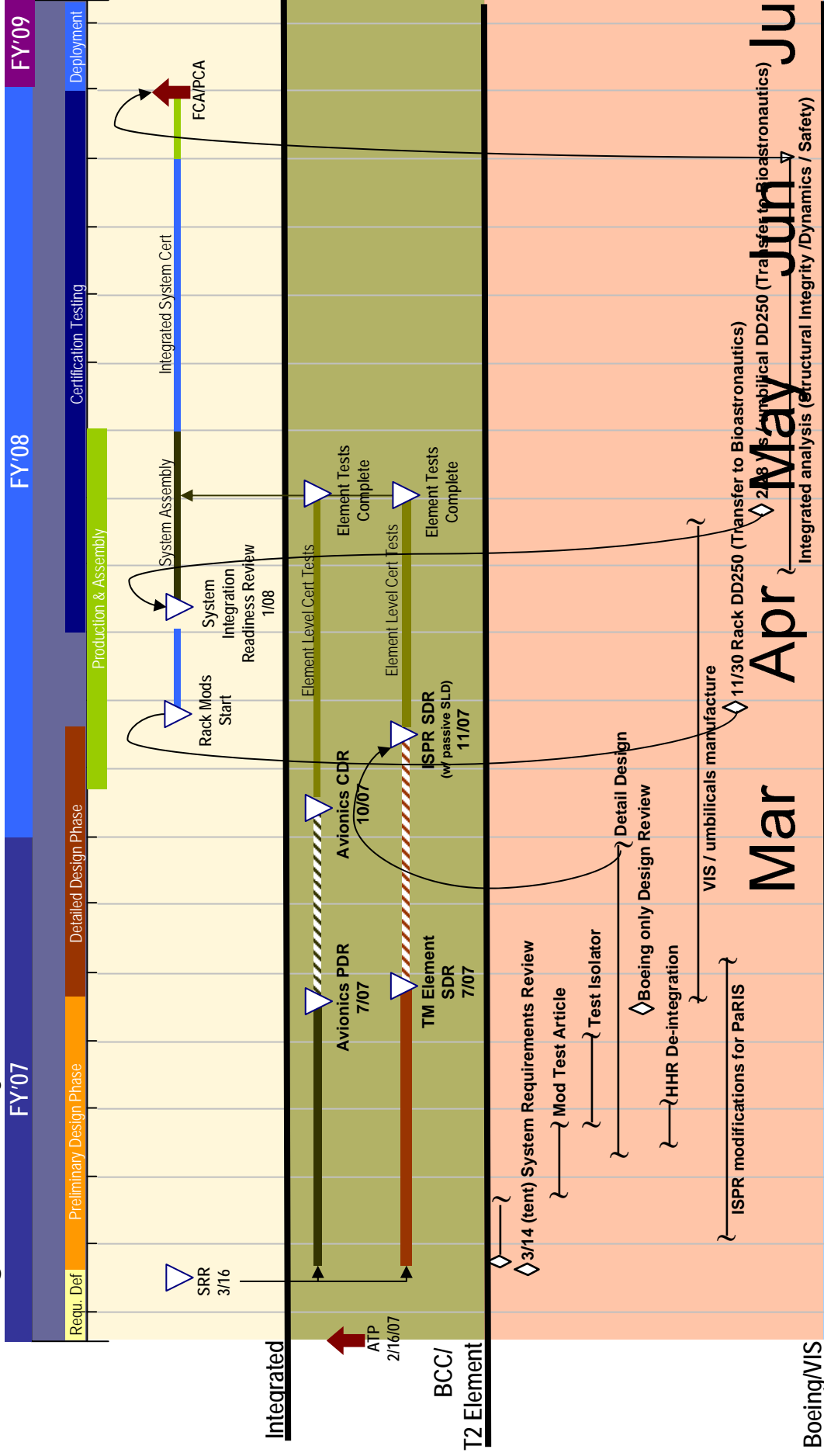
Summary Schedule



Major Milestones

- Authorization to Proceed required by 2/16/07
- Systems Requirements Review- 3/16/07
- ESA SLD Feasibility Review -4/07
- ESA SLD ATP Review- 5/07
- Avionics Element PDR/ system level consideration-July 2007
- Avionics Element CDR/System SDR- October 2007
- Treadmill Element SDR-July 2007
- ISPR Element (with passive SLD) SDR- November 2007
- System Integration Readiness Review- January 2008
- Element Level Certification Testing- December 2007- March 2008
- System Assembly- January - April 2008
- Integrated System Certification- April 2008- August 2008
- Systems Acceptance Review- September 2008
- Handover for MPLM Integration- September 2008

Integrated T2 Project Schedule



Boeing/VIS

SLD Feasibility Review 4/07

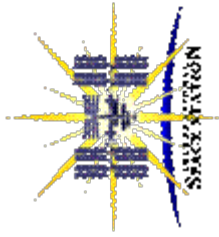
SLD ATP 5/07

TBD

Feb

ESA/SLD

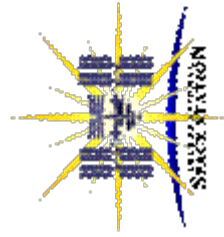
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T2 Project Challenges



- **JAXA is in full agreement with the development of a second ISS treadmill. However, they are concerned about microgravity disturbances that will result from T2 operations in the JEM as well as modifications to the existing MOU for resource allocations and accommodation rights in the Japanese Element.**
 - NASA is negotiating with JAXA to integrate the T2 under existing payload agreements and allocations. Anticipated microgravity disturbances and the utilization impacts will be worked with JAXA as they become further characterized.
 - Node 3 is a potential back up location for the T2 but would require some modifications to accommodate the structure.
- **The ESA designed active SLDs will very likely not be launched with the rest of the T2 system. Ministry approvals and contracting with industry will delay start of SLD development. A delivery schedule for the SLDs is not anticipated until late 2007.**
 - NASA and ESA will communicate regularly on schedule and interface requirements. An ICD or IDD will be provided from NASA to ESA to aid in SLD design.
 - NASA will launch contingency/interim passive SLDs for crew use until such a time that the active SLDs are ready.
 - NASA will maintain a second flight-like T2 system for integrated testing of the ESA SLDs when they are delivered.
- **The PaRIS has been untested for attenuating the types of forces anticipated by crews running on the treadmill. Of special interest are those forces generated at very low frequencies.**
 - The existing PaRIS model is being supplemented from data recently collected at JSC using the Woodway Path as a running platform. Data from the testing is expected to be ready to support the SRR on March 15th.

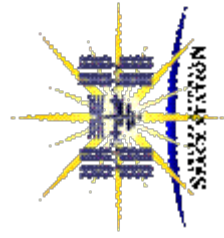


Alignment of COTS Design Approach with Unconstrained MMOP Requirements



- See Attachment

Back Up Slides



Change Definition/Background



- **PaRIS ISPR Modification Requirements**

- Upper Isolator Assembly Attachment Points
 - Drill Holes in Composite Skin (current on '402 drawing)
 - Attach Backing Plate to Skin using Eddie Bolts (current on '402 drawing)
 - Add 2 Velcro Strips (Hook; 2 inch x 1.5")
- Lower Isolator Assembly Attachment Points
 - Drill Holes in Composite Skin (qty 4) for Spacer/Isolation Plate Attachment (new interface)
 - Attach Z-axis Isolator Attachment Bracket to Skin using Eddie Bolts (current on '402 drawing)
- Composite Skin Relief for Z-axis Isolator (current on '402 drawing)
- Accommodation of Z-axis Rotation Snubbers (new interface)
- Accommodation of Isolation Plate rear Standoffs (new interface)



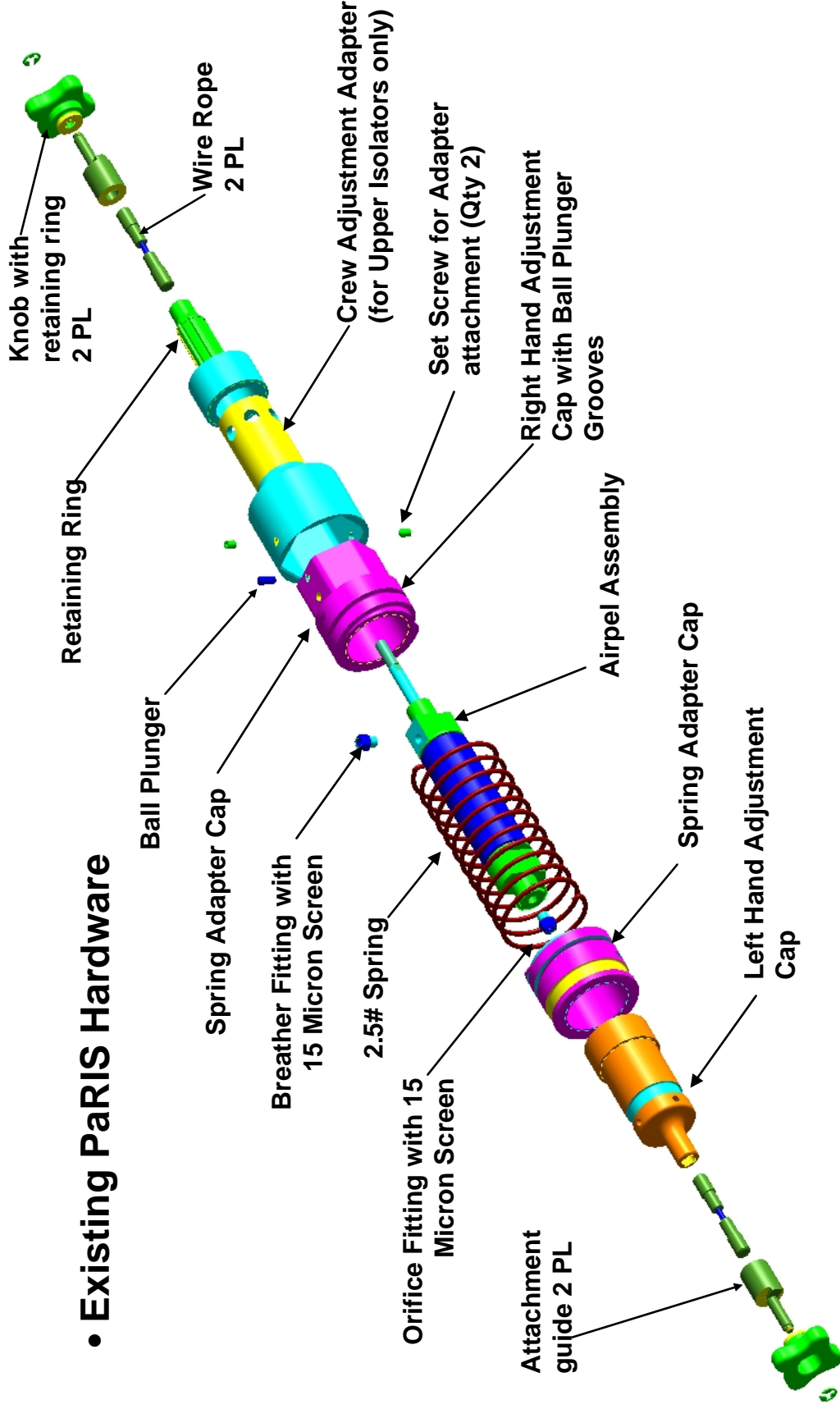
- Existing PaRIS Hardware





Change Definition/Background

- Existing PaRIS Hardware



Change Definition/Background

